National Institutes of Health

Fact Sheet

Optical Imaging

Optical Imaging is an emerging technology with great potential for improving disease diagnosis and prevention due to significant advantages over existing radiological imaging techniques. First, the radiation used is non-ionizing, and therefore reasonable doses can be repeatedly used without harm to the patient. Second, optical methods offer the potential to differentiate between soft tissues--due to their different absorption or scatter at different wavelengths--that are indistinguishable using other modalities. Third, specific absorption by natural chromophores, the part of the molecule responsible for generating its color, allows functional information to be obtained.

Yesterday

- During the last 15 years, rapid advances and developments in biophotonics (the science and technology of the interaction of photons within and on biological systems) have resulted in promising innovations with broad applications in high-resolution imaging.
- Advances in genetics and genomics spurred applications to image cellular activity, such as visualization of gene expression in real-time, as well as detection of protein synthesis during biologic processes. The ability to probe physiology and molecular function using optical imaging enhances diagnostic accuracy and plays a vital role in therapeutic strategy and monitoring.

Today

- Recently, techniques transferred from the laboratory to the clinic resulted in the development of a broad variety of diagnostic technologies and applications, in particular imaging of the breast and the adult and infant brain. For example:
  - To improve the accuracy of surgical biopsies, NIH-supported researchers used tiny-fiber optic probes to detect malignant tissues. Women confronting breast cancer may soon have a more accurate test without undergoing painful surgical biopsies. Moreover, the number of cancers that go undetected could be reduced.
  - NIH-funded researchers are using optical coherence tomography (OCT) to develop methods to identify vulnerable coronary plaques associated with heart disease and to accurately guide placement of treatment probes in deep-brain structures for the treatment of Parkinson's disease.
  - Researchers developed a new technique that combines flexible "microbubbles" and optical imaging to detect dormant metastatic cancer cells as well as improve tumor staging and classification. These synthetic but biocompatible nanoparticles offer a new mode of transport of optical imaging agents as well as an improved method of disease detection and surveillance.
  - Modalities such as multiphoton microscopy are being used to study living cells and tissues without inflicting damage. This technique is used to study amyloid plaques associated with Alzheimer's disease and fibrous collagen deposits associated with many liver diseases.

Tomorrow

- The ability to image, analyze, and manipulate living tissue at the cellular and molecular levels will enhance the practice of medicine, making it more predictive, personalized, and preemptive. While impressive, the progress has been evolutionary rather than revolutionary. Further transfer of these new techniques into clinical tools remains a demanding problem and requires close collaboration between imagers, engineers, clinicians, mathematicians, and basic scientists. To advance this important field, the NIH remains committed to funding *in vivo* optical imaging translational research.

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